Models of Trust and Reputation in eCommerce

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Abstract: In eCommerce it is offered to online clients three types of evaluation: the evaluation of the buyer, the evaluation of the seller or the evaluation of both of them. For most of the cases, the partners of transaction can evaluate each other. In general, evaluations show how satisfied or unsatisfied is a buyer or a seller about the online transaction or his partner after the ending of the process. A small number of models offers a solution for developing an initial set of advisors which can be used for determination of levels of reputation and there are a few models that take into consideration as many social criteria as possible for determination of trust.

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The essential concept of Amazon.com and eBay models is reflected in the average of all the ratings that are taken as an entity, as a value of a reputation. This type of model is called, in the specialty literature, the traditional model of reputation. I will try to outline an image of models of trust.

Marsh's Model

Marsh's researches are the first in which the trust is separated into three different aspects: basic trust, general trust and situational trust. He sees the basic trust as the evaluator agent's provision of trust, based on his entire past experience. The general trust is the general trust on the evaluated agent without any situational clue and, in the same time, the situational trust is the one which depends on the situation and on the context in which the agent is evaluated. The usefulness, the importance of Marsh's model and the factors of knowledge are introduced for determination of situational trust. The elementary equation for the calculation of situational trust's is:

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$Tx(y,\alpha)t=Ux(\alpha)t \ X \ E(Tx(y)t)$ (1)

Where:

X – evaluator agent;

Y - evaluated agent;

α - the situation;

$Ux(\alpha)^t$ - the usefulness earned by x in situation α,

$Yx(\alpha)^t$ - the importance of situation α ,

$E(Tx(y)^t)$ - estimation of basic trust of x to y at time t.

Knowledge as a binary variable, indicates whether the agent evaluator knows the assessed or not, and the importance, as a real number between [0; 1], indicates how important is the situation for the agent evaluator. However, this solution produces a few meaningless behaviors of the agent. For example, the negative usefulness and negative estimation of basic trust produces a positive value to the situational trust. To determine whether the agent evaluator should cooperate with the assessed, the cooperation is based on the perceived risk, perceived competence, estimation of general trust and importance of the situation, as in the following equation:

$$I^x(\alpha)= \frac{perceput\_risc_x(\alpha)}{perceput\_competenta_x(y,\alpha)+E(T_x(y))} \times I_x(\alpha) \quad (2)$$

in which the perceived risk is not formalized. Again, this equation leads to some meaningless behaviors. During the evaluation of the trust's agent, this model takes into consideration only the evaluator agent's experiments and does not take into account interactions and experiments of other agents with evaluator agent.

Esfandiary's and Chandrasekharan's Model

In the model of trust proposed by Esfandiary and Chandrasekharan are proposed two mechanisms of knowledge acquisition. The first mechanism of knowledge acquisition is based on observation and uses Bayesian Networks in this regard. In accomplishing the trust acquisition, the learning is reduced to statistical considerations.

The second mechanism of trust acquisition is based on interaction, the same approach used in Lashkari. There are two main situations of interaction: Explorer protocol where the agents ask other agents about known to evolve the confidence level and the query protocol where the agent asks for advice from other reliable

agents. To work with information from witnesses each agent creates a graph in which the nodes are represented by agents and arcs (a, b) represent the trust's a agent in b agent. The graph does not contain the arcs for which the value of trust is unknown. In such a graph, there exists the possibility of cycles to artificially decrease the level of trust and different paths that provide contradictory values of trust. To resolve this problem, instead of using one single value of trust, the model uses a trust interval determined by the minimum value, i.e. the maximum value of all the roads without cycles which link two agents.

The authors propose a mechanism for trust acquisition using institutions which leads to institutionalized trust. This trust is similar to the concept of reputation ReGret system developed by Sabater and Sierra which will be presented broadly in this work.

YU and Sing Model

The model proposed by Yu and Sing brings in the main plan information stored by an agent about direct interactions, as a set of values that reflects the quality of the interactions (what they call Qos). Using archived information, in line with Dempster-Shafer's theory of track, an agent can calculate the probability that his partner will conduct a service. There are two types of information that can be derived from witnesses interrogated about a target agent. If the target agent is one of his acquaintances, he will provide information about him, if not, he will return the target agent references. References generate valid information that are taken into account if they are close to the limit depth of chain of references. The set of reference chains generated due to a query is a TrustNet.

Afras Model

The main feature of this model designed by Carbo consists in using of fuzzy sets to represent the values of reputation. Once a new fuzzy set which shows the degree of satisfaction of the last interaction with a nominated partner is calculated, the old value and the new value of the reputation of satisfaction are gathered using an aggregation based on weights. This weights of aggregation are calculated from a single value called remembrance or memory. This factor allows the agent to give more importance to the last interaction or to the old value of reputation. If the satisfaction of the last interaction and the reputation attributed to the partner are similar, the significance of the previous experiences is increased. The notion of reliability of the value of reputation is modeled by fuzzy sets. A broad fuzzy set for the value of reputation represents a high degree of uncertainty, while a narrow fuzzy set involves a value of trust. Recommendations from other agents are collected with direct experiences. The weight given to each factor (the old value of reputation and

the new opinion) depends on the reputation she has. Recommendations from a person with a good reputation have the same degree of trust as a direct experience, and the opinion of an agent with a bad reputation is not taken into account. To calculate the reputation of those who recommend, the agent compares the recommendation received with the real behavior of the one who recommends after interaction and increases or decreases accordingly his reputation.

Carter's Model

The main idea of the reputation model presented by Carter is that an agent's reputation is based on the degree of accomplishment of the roles assigned to him by the company. If the company believes that they have fulfilled the roles then they are rewarded with a positive reputation, otherwise they are punished with a negative reputation. Every society has its set of roles. So the reputation attributed as a result of these types of roles makes sense only in the context of that particular company. According to the authors, it is impossible to generalize the computation's reputation. Users should be encouraged to maintain a good reputation to promote the longevity of the system. The degree of satisfaction of this role is measured according to the level of the user's reputation.

Given that reputation is computed as a weighted sum of the degree of satisfaction of each role, the values are totally dependent on the specific company. The amount of reputation for each agent is calculated by a centralized mechanism which monitors the system. Therefore, the value of each user's reputation is a global measure shared by all observers.

Castelfranchi's and Falcone's Model

The model proposed by Castelfranchi and Falcone is a clear example of the cognitive model of trust. Their model is the close relationship between trust and delegation. They say that trust is the mental background of delegation. In other words, the decision taken by agent x to choose a task for agent y is based on a specific service of beliefs and goals, and this mental state is what we call trust.

- To create a mental state of trust, the agent should have the following basic beliefs:

Conviction of competence.

- The agent must be convinced that z may even fulfill the task.

Conviction of dependency.

- The agent thinks y must carry out the task or that it is better to rely on y to do it.

Conviction of provision.

- Agent not only believes that y must carry out the task, but y will do it 100%. If the agent is intentional, the belief provision should be articulated and advocated by another two beliefs:

Conviction of desire

- The agent believes that y has been decided and plans to make the action c which allows achieving g goal.

Conviction of persistency

- The agent y is stable in his intent to do action c.

Conviction of competence and conviction of dependency form what they call basic trust, and with conviction of provision form reliability. Supported and involved by previous convictions, there is a new conviction, the conviction of fulfillment

Abdul-Rahman's And Haile's Model

Researchers Abdul-Rahman and Hailes suggest a model of trust rooted in social trust from reality, based on the mechanism of spread by mouth.

These authors divide trust into 3 types:

- Interpersonal trust which is context-specific and depends on the direct trust that an agent has in another.
- Impersonal Trust which is based on structures and is known as trust based institutions.
- Dispositional trust, which is the basic trust in the trust model Marsh.

In fact only interpersonal trust is the shaped, forming four categories of levels of trust such as: vt (very reliable), t (trusted), u (not trustworthy) and vu (very unreliable). For each evaluated agent and each context, in a set Q, the evaluator agent maintains the pair of numbers corresponding to the experience of each category of trust.

The basic value of trust is not used directly for the formation of evaluated agent's value of trust, instead, it is used to calculate the distance semantics used to adjust the agent's testimony that recommended it.

Sen's and Sajja's Model

Sen and Sajja propose a model of trust based on reputation that uses a minimal number of witnesses and consider information from direct and seen interaction. An

agent needs to require evaluation of witnesses in order to guarantee the proper choice of provider. The following inequality is used to calculate the minimum number of witnesses q:

$$\sum_{i=\max([\frac{q}{2}],[\frac{q}{2}]+1)}^{p} \frac{C_{N-1}^{i} * C_{l}^{q-1}}{C_{N}^{q}} \geq g, \tag{3}$$

Where:

N-population of buyers agents,

P-population of sellers agents

l-false number that is less than or equal to N/2,

g-represents the probable proximity.

Agencies use learning by strengthening to know how to assess a provider's reputation through direct interaction with him or by observing the interactions of other agents and provider. Only direct interaction provides a presumption of reality. Learning by strengthening mechanism is selected for updating the value of reputation. Due to the noise from the information, the rule used to update the value of reputation when a new direct interaction appears, has a bigger effect than the rule used to update the value when there is a new observation. The value of reputation ranges between 0 and 1. A value bigger than 0.5 means a good provider and value less than 0.5 means a bad provider. Agents may interrogate other agents on the performance of a particular partner. The answer is always a Boolean value that indicates whether the partner is good or not. In this model, the subgroup of the agents who will be query are randomly selected from the group of potential witnesses, though, the author says that it is easier to add a quick selection whose process is based on a mechanism of trust.

Since the objective of this model was to study ways in which agents use a person's reputation for picking a partner among many partners, agents use only information from witnesses to get a final value of reputation.

Huang's Model

Huang proposes a model for training trusted agents in a trade from peer to peer. He defines his model starting from the next faith: trust is a psychological condition which includes:

Waiting-the one who has trust expects a particular behavior on the one in who he trusts (such as providing valid information, carrying out effective cooperative actions).

Faith-the one who has trust believes that waiting is real, based on proof of competence from the one who he trusts and his goodwill.

Willingness to be vulnerable-the one who has trust is ready to be vulnerable to the faith in a specific context in which the information is used or the measures are applied.

In the model, the value of the evaluated agent's trust is determined by the memory of assessor agent and represents a beneficial value of transactions carried out by the evaluated agent. An unclear process is used for forming agent's trust based on dates of entry of the corresponding testimony, however, builds a logical theory of trust in the form of the ontology that gives formal and explicit clarification for the semantics of trust.

Regret Model

ReGret is a modular system of trust based on reputation-oriented e-commerce environments in which social relations between people play an important role. The system takes into account three different information sources: direct experiences, information from third-party agents and information of social structure.

Direct trust module deals with direct experiences and with their contribution to trust in third party agents. Together with reputation model forms the basis for the calculation of the trust. Reputation model consists in three specialized types of reputation depend on what information source is used to calculate:

- The reputation of the witness calculated from information received from witnesses.
- Proximity's reputation calculated using the information extracted from the social relations between partners.
- System's reputation calculated from the amount of reputation based on roles and properties.

The system incorporates a system of credibility that allows the agent to measure the credibility of witnesses and their information, which uses to calculate their reputation. Modular system approach enables the agent to decide on which one they want to use.

The last element of ReGret is the ontological structure based on the grounds that the trust and reputation are not abstract, alone concepts, but rather concepts with more sides.

Conclusion

Most models of trust and reputation are not made to deal with a large amount of missing data (other buyers choose not to offer any feedback). In addition, if there is not a suitable mechanism, in fact they divide agents to endure the lack of information and to provide information for those who don't do that. An agent prefers not to import and choose a free strategy of coercion. Ontological structure provides necessary information to combine the values of trust and reputation-related to simple aspects to compute values which are associated with more complex attributes. The authors of ReGret believe that each person can have a different ontological structure to combine the values of trust and reputation, and a different way of giving weight to these values when they are combined. Trust in faith and confidence in performance are identified in Huang's model. Transitivity's trust is formally proven.

In Sen's and Sajja's model direct interaction of the evaluator is not integrated into the evaluation of testimony evaluated to obtain the value of evaluated reputation.

But the trust and reputation can be explored for many years by researchers in order to define patterns to represent as realistic as possible the electronic market.

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